# PATENT ABSTRACTS OF JAPAN

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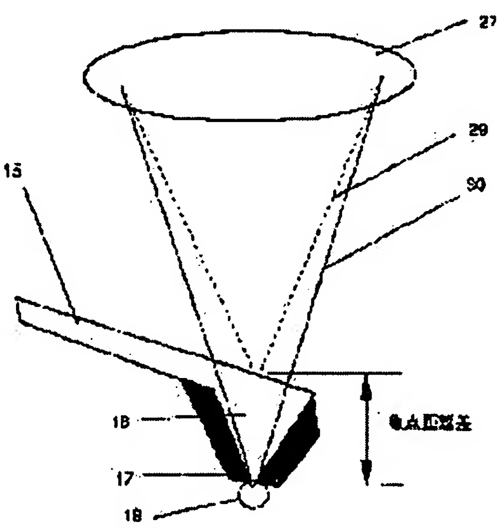
## (54) NEAR-FIELD LIGHT HEAD, AND OPTICAL RECORDING AND REPRODUCING DEVICE USING SUCH HEAD

(57)Abstract:

PROBLEM TO BE SOLVED: To miniaturize the device and to reduce crosstalk by making wavelength different between irradiation light for a near-field light generating probe and a cantilever displacement detecting light and thereby allowing common use between the irradiation optical system and the cantilever displacement optical system.




SOLUTION: Long wavelength light 30 and short wavelength light 29 are generated each by a separate semiconductor laser, and converged with a common objective lens 27. The long wavelength laser beam 30 is converged on a micro-opening 17 formed at the tip end of a cantilever 15, with a part of the beam turning to near-field light 18 from the micro-opening 17, and is used for recording and reproduction of signals for a medium. The short wavelength laser beam 29, having a different wavelength, is converged on the rear side face of the cantilever 15, with the converging position separated from that of the laser beam 30. In this case, a pyramid projection formed at the tip end of the cantilever 15 is set at a proper height in accordance with the wavelength of the laser beams 30, 29. Consequently, crosstalk of both

laser beams is suppressed, improving the ratio of the signal of the light 18 to a noise, and enhancing the detection accuracy of the cantilever displacement of the short wavelength laser beam.

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CLAIMS

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[Claim(s)]
[Claim 1] The approaching space light head characterized by to have the cantilever which has at a tip the probe for approaching space light generating with which minute opening was prepared, the 1st light source which emits the exposure light irradiated by said approaching space light generating probe, and the 2nd light source which emit the displacement detection light for detecting the variation rate of said cantilever, and for the wavelength of said exposure light to differ from the wavelength of said displacement detection light.
[Claim 2] The approaching space light head characterized by having a condensing means to condense said exposure light and said displacement detection light on opening of said probe for approaching space generating, and a cantilever, in an approaching space light head according to claim 1.
[Claim 3] The approaching space light head to which wavelength of said exposure light is characterized by the ******** from the wavelength of said displacement detection light in an approaching space light head according to claim 2.
[Claim 4] The approaching space light head characterized by having coating which penetrates said exposure light to a field opposite to the field where said opening of said cantilever is formed in either of claims 1-3 in the approaching space light head of a publication, and reflects said displacement detection light in it.
[Claim 5] In an approaching space light head given in either of claims 1-4, said condensing means has a lens and the vertical distance H of a field opposite to the field in which said opening of said cantilever is formed, and the cross section of said opening receives the wavelength L of said displacement detection light, and the numerical aperture NA of said lens. H>=2L/2 .............. (several 1)
The approaching space light head characterized by satisfying (several 1).
[Claim 6] The approaching space light head characterized by using the focal error detection method used with an optical recording regenerative-apparatus head as an approach of detecting the variation rate of said cantilever, in an approaching space light head given in either of claims 1-5.
[Claim 7] The approaching space light head characterized by using either the astigmatism method or the knife-edge method as said focal error detection method in an approaching space light head according to claim 6.
[Claim 8] The approaching space light head to which it has said condensing means, the movable device which amends the relative position of an optical recording medium, and a movable means to amend the relative position of said cantilever and said condensing means, in an approaching space light head according to claim 7, and said movable means is characterized by being installed in a part for the moving part displaced according to said movable device.
[Claim 9] The approaching space light head characterized by being installed on the 2nd movable device which said condensing means, said movable device, and said movable means are separated [ 2nd ] from the fixed part holding said the 1st light source and 2nd light source in an approaching space light head according to claim 7, and makes said approaching space light generating probe access the position of a record medium.

[Claim 10] The 1st from which wavelength differs, the light source which emits the 2nd laser beam, and the lens which condenses said the 1st and 2nd laser beam, The cantilever which has at a tip the probe for approaching space light generating with which minute opening was prepared, A displacement detection means to detect said 1st laser beam reflected by said cantilever after being condensed with said lens, and to detect the variation rate of said cantilever, The approaching space light head characterized by **** (ing), and for said 2nd laser beam condensed with said lens passing said opening, and generating approaching space light.
[Claim 11] The optical information record regenerative apparatus which becomes either of claims 1-9 from the approaching space light head of a publication, and an optical recording medium.

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* NOTICES *



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DETAILED DESCRIPTION

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[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the optical probe which generates especially approaching space, and the optical recording regenerative apparatus adapting it about the optical recording regenerative apparatus which used an approaching space light head and it.
[0002]
[Description of the Prior Art] The optical recording adapting approaching space light attracts attention as an approach of attaining the densification of an optical disk unit in recent years. For example, as indicated by 144 pages (144 62 Applied Physics Lettes, Vol. No. 2 and pp.142- 1992) from 142 pages of applied FIJIKUSU Letters, 61 volumes, and No. 2 Process the tip of an optical fiber in the shape of a cone, produce the probe which covered except several 10nm field at the tip with the metaled coat, carry this in the precision actuator using a piezo-electric element, and a location is controlled. The example which carried out record playback of the record mark with a diameter of 60nm on the multilayers of platinum/cobalt is reported. In the case of this example, the Xia force method which applied the force between atoms to the distance control of a probe and a record medium is used, and recording density becomes a 45-gigabit [/square ] inch, and can be made into about 50 times of the present condition. Furthermore, in JP,3-171434,A, while condensing light with a lens at a detailed pinhole and generating approaching space light, the approach of controlling the distance between an account detailed pinhole and a record medium using the force between atoms of generating between the cantilevers and record media which formed said detailed pinhole at the tip is devised. Although some methods of detecting the variation rate of said cantilever are proposed, the approach with which current practical use is presented is an optical-lever method which irradiates a laser beam at the tooth back of a cantilever, and changes and detects the variation rate of a cantilever to migration of the light spot on a linear photodiode. Furthermore, in JP,5-141961,A, the approach using an optical fiber interferometer as an approach of detecting the variation rate of a cantilever is devised. Furthermore, to 3533 pages (3533 68 Vol. No. Applied Physics Lettes, 25, pp.3531- 1996), from 3531 pages of applied FIJIKUSU Letters, 68 volumes, and No. 25 recently Actually open a pinhole at the tip of a cantilever at Si substrate using an etching technique with buffer fluoric acid liquid, deposit a metal, form a detailed pinhole, and a helium-Ne laser beam is condensed to this. Approaching space light was generated from the pinhole and the resolution of about 100nm has been obtained using this. In this case, the optical-lever method is too used for detection of the variation rate of a cantilever.
[0003]
[Problem(s) to be Solved by the Invention] However, there are the following technical problems in the above-mentioned conventional example.
[0004] It is first using the probe which the above-mentioned conventional example's processed the tip of an optical fiber in the shape of a cone, and covered except several 10nm field at the tip with the metaled coat in the first place about the above and the first conventional example. Such a probe has been used when applying approaching space light not only to optical recording but to various fields, such as

measurement, conventionally. However, it is becoming in recent years and clear that there are some problems in such a probe. For example, when such a probe is used as indicated by 185 pages (185 Vol. Ultramaicroscopy, 61, pp.179- 1995) from an ultra microscopy and 179 pages of 61 volumes, most is absorbed and lost by the clothing metal membrane in a part with a die length [ of the end of the probe ] of 10 microns among the optical power inputted into the optical fiber, and it is changed into heat energy and produces generation of heat. Since this generation of heat takes place intensively in the end-of-the-probe section and the probe itself is formed with the ingredient which is not large as for heat conductivity called a quartz, diffusion of heat will not be able to take place easily and only the temperature of an end-of-the-probe part will become very high. For this reason, the metal which has covered the probe fuses and the problem that a probe is damaged arises. Moreover, even when there is no temperature rise until a metal fuses, as a result of heating a point, the phenomenon in which the magnitude of opening increased effectually or the rate of metallic reflection fell arose, and there was a problem that fundamental properties, such as light transmittance of a probe and resolution, will change.

[0005] Moreover, the problem that the above-mentioned fiber probe does not have the enough repeatability of production is raised to the second. Conventionally, after it was radicalized in the optical fiber with the buffer etching reagent of fluoric acid and ammonium iodide, or it carried out the heat pull of the optical fiber and it was radicalized, the above-mentioned probe vapor-deposited the metal to the point, finally are approaches, such as etching, and was produced in the stroke of forming minute opening in a metal coat. However, in the approach of producing minute opening by etching etc., with the difference of few production conditions, dispersion in the diameter of opening arose and there were repeatability and a problem of not being suitable for mass production method.

[0006] When the disk which recorded optical information is rotated at a high speed since the fiber probe is used for the 3rd and it is necessary using a scanning force microscope to control the distance of a substrate and a probe to a precision extremely for example, there is a problem that the substrate of a high frequency and the fluctuation of the distance of a probe which are produced with the eccentricity of a disk cannot be controlled.

[0007] Furthermore, applied FIJIKUSU Letters who actually realized JP,3-171434,A and it, In a 3531 to 3533 pages [ of 68 volumes and No. 25 ] (3533 68 Vol. No. Applied Physics Lettes, 25, pp.3531- 1996) example Although the anisotropic etching process of Si is used as a production process, repeatability and high-volume production capability are improved and thermal conductivity is also further improved by using Si substrate The former the detection approach of the variation rate of a cantilever change of capacitance and laser interference measurement The optical-lever method is used, the latter needed large-scale optical system other than the exposure optical system which all make generate approaching space thru/or capacitance system of measurement, and there was a problem that equipment was enlarged and complicated. Furthermore, although the approach using an optical fiber interferometer as an approach of detecting the variation rate of a cantilever was used in JP,5-141961,A, there was a problem that equipment was enlarged and complicated too.

[0008] The purpose of this invention has good thermal conductivity, and its production repeatability is high, and it carries the probe for approaching space light generating suitable for mass production method, and is to offer the approaching space light head of a small and simple configuration, and the optical recording regenerative apparatus using it.

[0009]

[Means for Solving the Problem] A cantilever transparent on the optical target which has the probe for approaching space light generating with which a transparent probe is optically covered by the opaque screen, and minute opening is prepared in the point in this invention, The light source which generates the exposure light to this approaching space light generating probe, and the optical system which leads the light generated from this light source to this approaching space light generating probe, In the approaching space light head which has the light source which generates the light which detects the variation rate of a cantilever, and the optical system which leads the light you were made to generate in this light source to a cantilever the wavelength of the exposure light to an approaching space light generating probe, and the variation rate of a cantilever -- the location which both condense when the

wavelength of detection light shall differ -- things -- inside -- it is -- **. Furthermore, in the above-mentioned approaching space light head, when the exposure light to an approaching space light generating probe and the displacement detection light of a cantilever condense on minute opening for approaching space generating, and a cantilever with a common condensing means at least, the exposure optical system for approaching space light generating and the displacement detection optical system of a cantilever are communalized, and the miniaturization of equipment is attained. The wavelength of the exposure light to an approaching space light generating probe keeps away the condensing location of the exposure optical system to an approaching space light generating probe from the condensing location of the displacement detection optical system of a cantilever, and it is made to make the tooth back of a cantilever condense the latter for the former to minute opening by making it longer than the displacement detection light of a cantilever furthermore, respectively. Furthermore, in an approaching space light head, a field opposite to the field in which minute opening of a cantilever is formed is made to penetrate the exposure light to an approaching space light generating probe, coating which is made to reflect the displacement detection light of a cantilever and is closed is performed to it, and efficiency for light utilization is raised to it. Moreover, in an approaching space light head, the cross talk of approaching space generating light and the displacement detection light of a cantilever is prevented by making at least the vertical distance H of a field opposite to the field in which minute opening of a cantilever is formed, and minute opening to which approaching space light is generated and it closes into the value with which are satisfied of (several 1).
[0010]
[Equation 1]

$$H \geq 2L/(NA)^2 \quad \cdots\cdots \quad (数1)$$

L：変位検出光の波長

[0011] However, L is the wavelength of displacement detection light and NA is the numerical aperture of a lens.
[0012] The variation rate of a cantilever is detected further again as an approach of detecting the variation rate of a cantilever in an approaching space light head, without either the focal error detection method used with an optical recording regenerative-apparatus head, for example, an astigmatism method, and the knife-edge method using, and using large-scale optical system, such as an optical-lever method and a fiber interference method.
[0013] It enables it to amend a gap of the location of the exposure light to the cantilever at the time of equipment assembly and an approaching space light generating probe and the convergence light of the displacement detection light of a cantilever by establishing the movable device which amends the relative position of a cantilever and the condensing means of the exposure light to an approaching space light generating probe, and the displacement detection light of a cantilever in an approaching space light head further again.
[0014] It installs in the moving part of the movable device which amends the condensing means of the exposure light to an approaching space light generating probe, and the displacement detection light of a cantilever, and the relative position of an optical recording medium, and it enables it for a cantilever and a condensing means to move in one a movable means to by_which an approaching space light head amends a relative position with the condensing means of the exposure light to an approaching space light generating probe, and the displacement detection light of a cantilever, during actuation of an optical head further again.
[0015] It sets on an approaching space light head further again. At least The condensing means of the exposure light to an approaching space light generating probe, and the displacement detection light of a cantilever, A movable means to amend the relative position of a condensing means, the movable device which amends the relative position of an optical recording medium, and the condensing means of the

exposure light to a cantilever and an approaching space light generating probe, and the displacement detection light of a cantilever It dissociates from other components which constitute an approaching space light head, it carries on the movable device in which an approaching space light generating probe is made to access the position of a record medium, and moving part is lightweight-ized, and high-speed access is closed if .

[0016] An optical information record regenerative apparatus consists of the approaching space light heads and record media which have the above structure further again.

[0017]

[Embodiment of the Invention] Hereafter, the example of this invention is explained using a drawing.

[0018] Drawing 1 is one example of the approaching space light head of this invention, drawing 1 (a) is drawing which looked at the whole head from the top, and drawing 1 (b) shows the sectional view, the optical recording medium, and detection optical system of separation moving part of said head. In drawing 1 R> 1 (a), 1 expresses a part for the moving part which actually moves at the time of information access in an approaching space light head. 2 expresses a reflecting prism and 3 expresses the fixed part of an approaching space light head. The polarization beam splitter for the laser beams of long wavelength in 4, the filter with which 5 and 21 shade the laser beam of short wavelength, and the light of long wavelength is made to penetrate, A collimate lens and 7 6 The semiconductor laser of long wavelength (for example, wavelength of 780nm), 8 a condenser lens and 10 for a half mirror and 9 A cylindrical lens, 11 -- a cantilever -- the detector which detects a variation rate, and 14 -- the semiconductor laser of short wavelength (for example, wavelength of 680nm), and 12 -- a long wave -- the filter which cuts merit's laser beam 30 and lets only the laser beam 29 of short wavelength pass, and 13 are lenses which collimate a laser beam. Furthermore, the cantilever in which the projection 16 which has the minute opening 17 by which 15 was opened at the tip by the metal membrane in drawing 1 (b) was formed, The approaching space light for which 18 was generated by the minute opening 17, and 19 A record medium, The photo multiplier to which 20 detects a condenser lens and 22 detects the signal from a medium, The actuator used in order that 23 may carry out alignment of the cantilever 15, The attaching part to which 24 holds an objective lens 27, the lens actuator to which 25 moves an objective lens 27, the flat spring to which 26 holds the objective lens barrel 28, and 29 express the light of short wavelength, and 30 expresses the light of long wavelength.

[0019] Hereafter, this example is explained to a detail. In this example, the light of two different wavelength, and 29 and 30 are used for detection of the variation rate of a cantilever, generating of approaching space light, signal record to a medium, and playback, respectively.

[0020] First, the laser beam (for example, wavelength of 780nm) 30 of long wavelength is used for generating of approaching space light and record of a medium signal, and playback. Semiconductor laser 7 is installed so that it may have the polarization direction in the direction perpendicular to space. A laser beam with a wavelength of 780nm which carried out outgoing radiation from semiconductor laser 7 is changed into parallel light by the collimate lens 6, after it penetrates the filter 5 which prevents the return light of the laser beam of the short wavelength to laser, since it is polarizing in the direction perpendicular to space, penetrates a polarization beam splitter 4, and is led to the separation moving part 1. The laser beam 30 of the long wavelength led to the separation moving part 1 is changed in an optical path 90 degrees by prism 2, and it converges it on the minute opening 17 which is an objective lens 27 and was formed at the tip of a cantilever 15. Although the light which it converged is almost reflected by the metal membrane, the part interacts with a leakage broth and a medium 19 as an approaching space light 18 from the minute opening 17. The output power of semiconductor laser 7 is modulated at the time of record; it modulates the power of the approaching space light 18, and records information. The power of semiconductor laser is set constant at the time of playback, it condenses the light modulated as a result of the interaction of the approaching space light 18 and a record mark with a condenser lens 20, removes the component of the laser beam 29 of the short wavelength mixed with the filter 21, and detects it as a regenerative signal by the photoelectron redoubling 22.

[0021] On the other hand, the laser beam (for example, wavelength of 680nm) 29 of short wavelength is used for detection of the variation rate of a cantilever. 14 is installed so that semiconductor laser may

have the polarization direction in the direction too parallel to space. It is collimated by parallel light by the collimator lens 13, and a half mirror 8 is penetrated, although it has the polarization direction parallel to space therefore, it reflects by the polarization beam splitter 4, and the laser beam which carried out outgoing radiation from semiconductor laser 14 is led to the separation moving part 1. The laser beam 29 of the short wavelength led to separation moving part is changed in an optical path 90 degrees by prism 2, and it is an objective lens 27 and it converges it on the rear face of a cantilever 15, i.e., the field in which the projection 17 in which the minute opening 17 for approaching space light 18 generating was formed was formed and the field of the opposite side. It reflects by the half mirror 8 and the short-wavelength-laser light 29 reflected with the rear face of a cantilever is led to a detecting element, after passed along the objective lens 27 again, having reflected by prism 2, being led to a fixed part 3, reflecting by the polarization beam splitter 4 and removing the laser beam 30 of long wavelength with a filter 12. the quadrisection photodetector 11 since the astigmatism method used for detection of the variation rate of a cantilever in this example as a method which detects a focal error with an optical disk unit is used, after the light reflected by the half mirror penetrates the cylindrical lens 10 which gives a condenser lens 9 and astigmatism -- it is -- a cantilever -- a variation rate is detected. In addition, although this example showed the example which used the astigmatism method as the focal error detection approach, even if it uses other approaches, such as the knife-edge method, as the focal error detection approach, the same effectiveness is completely expectable.
[0022] Next, generating of approaching space light and detection of the variation rate of a cantilever are explained using drawing 2 . Drawing 2 is the enlarged drawing for a point of a cantilever 15. It is condensed with an objective lens 27 and converges the laser beam 30 of long wavelength on the minute opening 17 formed at the tip of a cantilever 15. The height of the part of the square drill formed at the tip of a cantilever 15 is about 6 microns. Since the refractive index of glass changes with light wave length when using the aspheric surface glass lens used from the former as an objective lens 27, a lens focal distance changes with wavelength of the light to be used. a long wave -- when wavelength of the laser beam of 780nm and short wavelength was set to 680nm for the wavelength of merit's laser beam and the laser beam 29 of short wavelength is condensed with the same objective lens since about 5 microns of focal distances become short when using the objective lens of numerical aperture 0.5, for example, exactly, it is condensed by the rear face of a cantilever 15 like drawing 2 , and a laser beam 29 can separate the condensing location of a laser beam where two wavelength differed. It is important how the condensing location of such two laser beams is separated in order to improve the signal-to-noise ratio of the signal light from the medium by approaching space light, and the displacement detection light of a cantilever. In this invention, both are condensed with a common objective lens, and although it is the method separated using the difference in a focal distance to both, it becomes an important parameter how much focal distance of a difference there should just be. According to Chapter 8 of "the theory of optics" (Tokai publication meeting) of Born and UORUFU work, and 660 pages, the intensity distribution which met the optical axis of the light condensed with the lens are expressed with (several 2).
[0023]
[Equation 2]

$$I = I_0 \left[ \frac{\sin\left(\frac{\pi (NA)^2}{2L} z\right)}{\frac{\pi (NA)^2}{2L} z} \right]^2 \cdots\cdots (数2)$$

$z$：焦点からの光軸方向の距離

$L$：変位検出光の波長

NA：集光レンズの開口数

[0024] When the objective lens of numerical aperture 0.5 is used for the location of the 1st zero point of the function of the right-hand side of (several 2) as mentioned above, for example, it will be called 8 times of light wave length. Since 780nm and **** stopped 680nm, and this distance become 6.24 and 5.44 microns about the wavelength of the laser beam to be used, height of 6 microns of the above-mentioned square drill is an appropriate value, by this, can inhibit the cross talk to the light 30 of the long wavelength of the light 29 of short wavelength, and can improve the signal-to-noise ratio of approaching space light. since the first zero point of (several 2) is generally given by **2l./2 -- the light 29 of short wavelength, and a long wave -- if the condensing point of merit's light 30 separates or more **2l./(NA)2, namely, (several 1) optical system is designed so that it may fill, and the projection of a cantilever 15 is designed, it turns out that a cross talk can be inhibited enough. Furthermore, if the laser beam 29 with a wavelength of 680nm is reflected in the rear face of a cantilever 15, coating which penetrates the laser beam 30 with a wavelength of 780nm is performed and it enables it to use a laser beam with a wavelength of 780nm for generating of the approaching space light 18 100%, while raising a signal-to-noise ratio further and being closed, it is made to reflect and a 680nm laser beam can be used only for detection of the variation rate of a cantilever 15. A part serves as the approaching space light 18 from the minute opening 17, and, as for most, the laser beam 30 of the long wavelength which it converged on the minute opening 17 formed at the tip of a cantilever 15 also injects it, although almost reflected by the metal membrane formed in the square conical surface and a front face. This approaching space light bears record and playback of the signal to a medium as mentioned above.

[0025] It is not easy to attach a cantilever 15 according to the condensing location of laser beams 29 and 30. It is because the precision of 1 micron or less is required as the installation precision. Therefore, in this example, driving an actuator 23, after carrying out alignment of an outline under a microscope in the condition of having made the laser beam 29 emitting light and attaching a cantilever 15 for an actuator 23, it has the device in which the location of a cantilever 15 is adjusted so that the optical power detected with a detector 11 may become max. While being able to ease the alignment precision at the time of cantilever installation by using justification of the final cantilever 15 using this actuator 23, it is effective in the ability to adjust the location gap with the condensing location of the light 30 of long wavelength by a delicate gap of the optical axis for every optical head, dimension dispersion of a cantilever, etc., and the light 29 of short wavelength, and the rear face of a cantilever and the minute opening 17 for approaching space light 18 generating.

[0026] Next, a medium disk vibrates up and down, or the servo to the vertical vibration of a cantilever when irregularity is shown in a medium front face is explained. Drawing 3 shows servo actuation when a medium disk vibrates up and down. If a medium disk moves up and down like drawing 3 (a), a cantilever 15 will fluctuate along with it. A variation rate is detected by the photodetector 11 as a focal error by the astigmatism method under besides. Like actuator 25 HE tradition ** of an objective lens 27, and drawing 3 (b), this signal amends the location of an objective lens 27 so that a focal error may serve as zero. At this time, a cantilever 15 will be attached for the moving part which moves with an objective lens, and by this, as it is in an objective lens and an always fixed relative position, a servo will be

applied by the cantilever. If the vertical vibration of the above-mentioned disk assumes rotational frequency 3600rpm of the usual optical disk, since the frequency is at most 60Hz, it can fully respond in the servo band of the lens actuator 25.

[0027] To the minute irregularity on the front face of a medium, it becomes the following actuation. For example, if the glass disk currently used with the magnetic disk is assumed as a disk for media, the minute irregularity of about several 10nm may remain from the number of height on the front face. When a head is in the location of 20mm from a core at the aforementioned engine speed, the peripheral speed of the disk in the location is about 7.5m/second. Although the resonance frequency of a cantilever 15 is decided by dimensions, such as the die length of a cantilever, and thickness, in the case of the cantilever with a die length [ of 12.5 microns ], and a height [ of the part of a square drill ] of 5 microns made from diacid-ized silicon, resonance frequency is about 4MHz and load rates are about 2 N/m, for example. If an about [ 10-7N ] load is applied to this cantilever, since it becomes large about about 4 times, resonance frequency can be set to about 15MHz. Therefore, on the disk of the above-mentioned peripheral speed, to irregularity (a period is equivalent to the irregularity of about 500nm or more) with a frequency of 15MHz or less, the spring of a cantilever 15 follows and it is satisfactory. although the actuator 25 of said objective lens does not answer, since it is in the depth of focus of the light which the height of said irregularity is 10nm in extent from a number, and was condensed with the objective lens 27 on the other hand in this frequency band -- the light 30 for approaching space generating, and a cantilever -- a variation rate -- it is condensed on minute opening and a cantilever, respectively, and a problem does not produce the detection light 29. Furthermore, although the spring of a cantilever does not answer to irregularity (a period is equivalent to the irregularity of about 500nm or less) with a frequency of 15MHz or more, since the irregularity of this period is the very small amplitude of 10nm or less, the approaching space light 18 does not produce a problem from the description that reinforcement hardly declines from an opening location to the distance of magnitude extent of the minute opening 17, in record playback of a signal.

[0028] As mentioned above, according to this invention, when the wavelength 30 of the exposure light to the approaching space light generating probe adapting a cantilever 15 for record playback shall differ from the wavelength of the displacement detection light 29 of a cantilever 15 the location which both condense -- things -- inside bundles and the exposure light 30 to said approaching space light generating probe, and the variation rate of said cantilever -- by condensing the detection light 29 on the minute opening 17 for approaching space generating, and a cantilever with the common lens 27 The exposure optical system for approaching space light generating and the displacement detection optical system of a cantilever are communalized, and it is effective in the ability to attain the miniaturization of equipment. As an approach of detecting the variation rate of said cantilever in said approaching space light head, by using the focal error detection method used with an optical recording regenerative-apparatus head, much more miniaturization of equipment and simplification can be attained and it is effective in the ability to offer a practically realistic approaching space light head further again.

[0029]

[Effect of the Invention] According to this invention, miniaturization of equipment and simplification can be attained and a practically realistic approaching space light head can be offered.

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[Translation done.]

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## DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]
[Drawing 1] In drawing showing one example of this invention, it is drawing in which (a) is drawing which looked at the whole head from the top, and (b) showed the sectional view, the optical recording medium, and detection optical system of separation moving part of said head.
[Drawing 2] The enlarged drawing near an approaching space light probe.
[Drawing 3] The moving part where (b) includes the signal detected with a motion of a cantilever when a medium disk carries out vertical vibration of the (a) in drawing having shown servo actuation when a medium disk vibrates up and down for an objective lens or a cantilever by servo actuation is drawing explaining how it moves.
[Description of Notations]
1 -- Separation moving part,
2 -- Reflecting prism
3 -- Fixed part of an approaching space light head,
4 -- Polarization beam splitter for the laser beams of long wavelength,
5 21 -- Filter which the laser beam of short wavelength is shaded [ filter ] and makes the light of long wavelength penetrate,
6 -- Collimate lens,
7 -- Semiconductor laser of long wavelength,
8 -- Half mirror,
9 -- Condenser lens
10 -- Cylindrical lens,
11 -- Detector which detects cantilever displacement,
12 -- Filter which cuts the laser beam of long wavelength and lets only the laser beam of short wavelength pass,
13 -- Collimate lens,
14 -- Semiconductor laser of short wavelength,
15 -- Cantilever,
16 -- Projection,
17 -- Minute opening,
18 -- Approaching space light,
19 -- Record medium,
20 -- Condenser lens
21 -- Filter which cuts the light of short wavelength,
22 -- Photo multiplier,
23 -- Actuator used in order to carry out alignment of the cantilever,
24 -- Objective lens attaching part,
25 -- Objective lens actuator,
26 -- Flat spring

27 -- Objective lens
28 -- Lens ****,
29 -- Light of short wavelength,
30 -- Light of long wavelength,
31 -- Stanchion.

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[Translation done.]

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DRAWINGS

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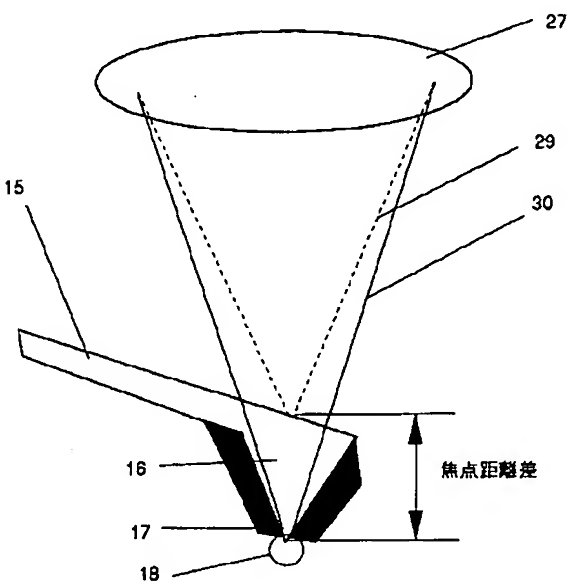
[Drawing 2]

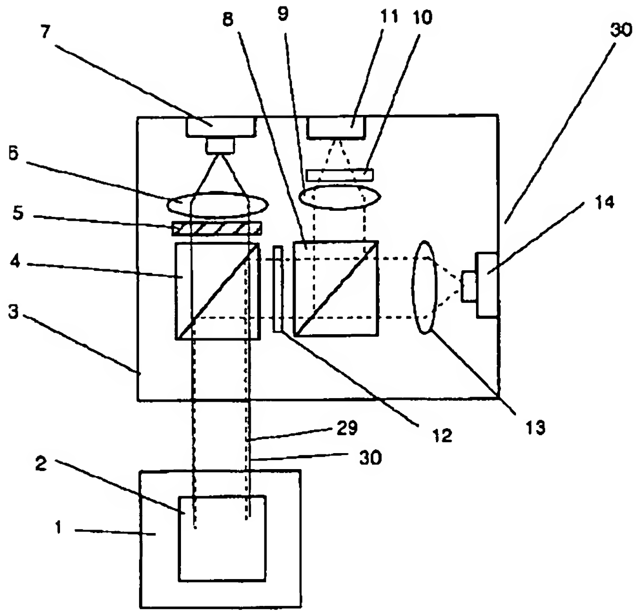
図 2



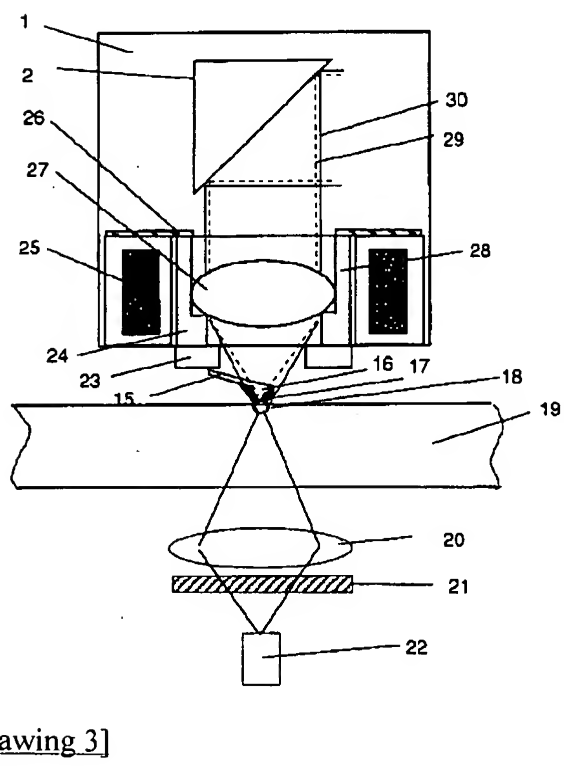

[Drawing 1]

図 1

(a)



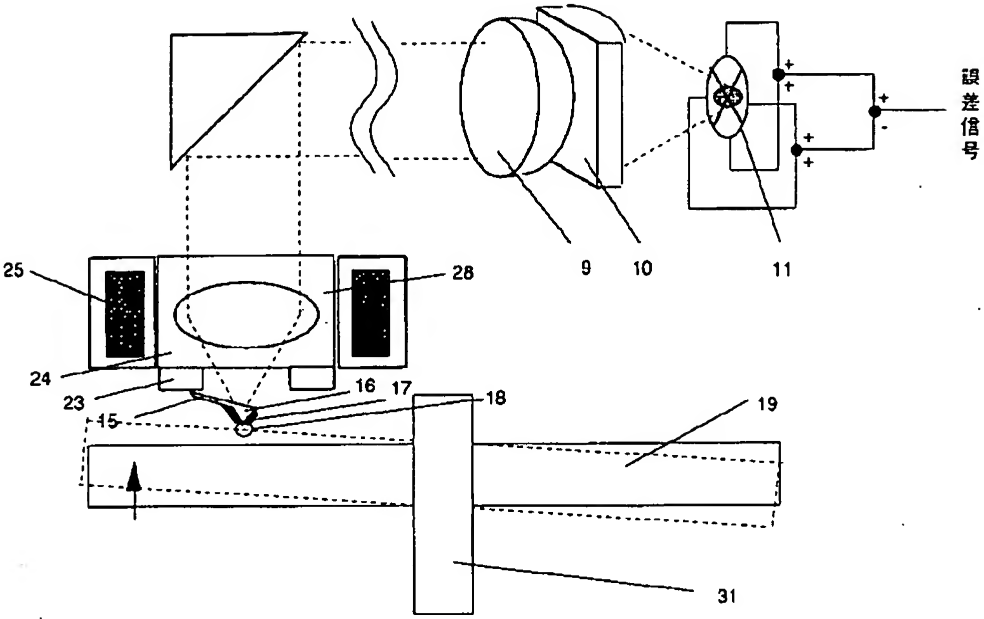

(b)



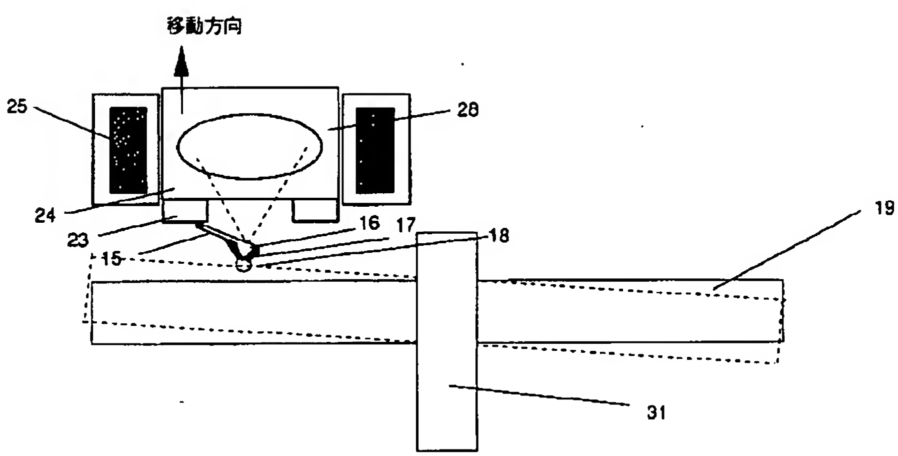

[Drawing 3]

図3

(a)




(b)




[Translation done.]